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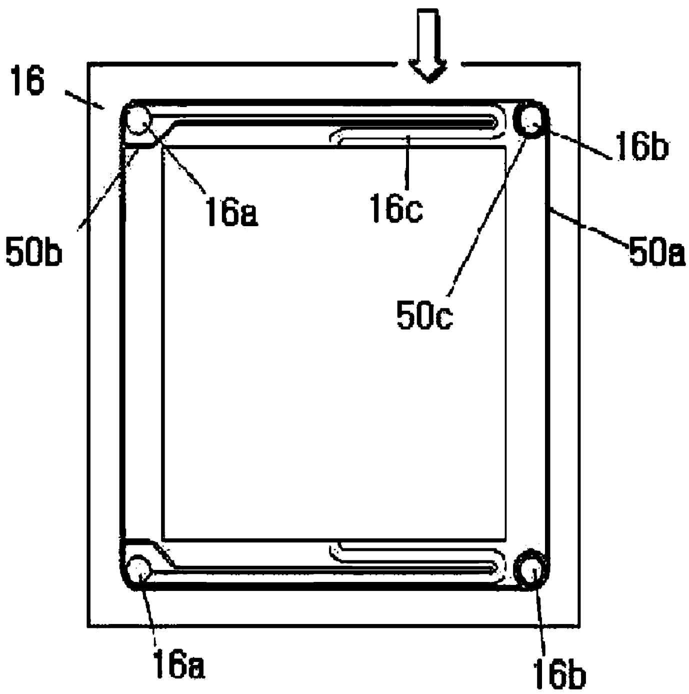
(54) **REDOX FLOW BATTERY OR FUEL CELL STACK PROVIDED WITH SEAL FOR PREVENTING SHUNT CURRENT LOSS**

(57) The present invention relates to a redox flow battery or fuel cell stack including an end plate, an insulating plate, a current plate, a bipolar plate, a flow frame, and an ion exchange membrane and having a structure in which a seal groove is mounted only on one side so as to improve the form and assembly of a seal for preventing shunt current loss.

[Fig. 7]



EP 3 024 075 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to a seal used for preventing leakage of an electrolyte from a redox flow battery or a fuel cell stack.

BACKGROUND ART

[0002] A redox flow battery is one of the core products closely associated with a new renewable energy, greenhouse gas mitigation, a secondary battery, and a smart grid, which have recently aroused the greatest interest around the globe, and a fuel cell is a new energy generation source alternate to fossil fuels and a product, a market of which rapidly expands around the globe. Recently, most energy has been acquired from fossil fuels, but there are limitations in that energy efficiency is low, and the use of the fossil fuels exerts on a seriously bad influence on an environment, such as air pollution, acid rain, and global warming.

[0003] In order to solve the limitations due to the use of the fossil fuels, high expectations are being placed on the new renewable energy and the fuel cell. In Korea and around the glove, interest in the new renewable energy rises, and research is actively conducted on the new renewable energy.

[0004] A new renewable market reaches a maturity stage inside and outside of Korea, but there is a limitation in that an amount of an energy generated is significantly changed according to an environmental effect such as a time and weather due to the characteristics of a renewable energy. Accordingly, in order to stabilize the new renewable energy, there is a need for spread of an energy storage system (ESS) storing the generated renewable energy, and a redox flow battery has received attention as the mass energy storage system.

[0005] Many technologies have been developed on the fuel cell due to eco-friendly characteristics and an unlimited resource rate, and fuel cell vehicles, generators, heating systems using the fuel cell have been developed and sold. However, up to now, the fuel cell is difficult to manufacture, assemble, and maintain.

[0006] As illustrated in FIG. 1, a general structure of a redox flow battery, to which the present invention is applied, includes a stack 1 formed by stacking cells in which an electrochemical reaction occurs, a tank 3 storing an electrolyte, and a pump 4 supplying the electrolyte from the tank storing the electrolyte to the stack.

[0007] FIG. 2 illustrates a simplified structure of the stack 1, and FIG. 2 illustrates an end plate 11-an insulating plate 12-a current plate 13-a bipolar plate 14-a gasket 15-an electrode 17-a flow frame 16-a gasket 15-an ion exchange membrane 18-a gasket 15-an electrode 17-a flow frame 16-a gasket 15-a bipolar plate 14-a current plate 13-an insulating plate 12-an endplate 11 from a left side. A unit cell includes the bipolar plate 14 to the bipolar plate 14, and generally, one stack is formed by stacking several ten to several hundred unit cells.

[0008] In the present invention, the term "plate" indicates configurations such as the end plate 11, the insulating plate 12, the current plate 13, the bipolar plate 14, and the flow frame 16, which constitute the stack 1 having a plate shape.

[0009] In order to prevent the leakage of the electrolyte, a seal 50 or the gasket 15 is disposed between components of the stack.

[0010] When the stack is assembled, the seal 50 is compressed to prevent the leakage of the electrolyte (see FIG. 3).

[0011] The seal 50 is mounted so as to be inserted into a groove formed in a contact surface of the plate such as the end plate 11, the insulating plate 12, the current plate 13, the bipolar plate 134, or the flow frame 16, which is stacked on and under the seal 50. A size of the groove is equal to or greater than a cross sectional area of the seal 50, and thus, after the seal 50 is compressed, the seal 50 is designed so as to fill an inside of the groove (see FIG. 3).

[0012] Generally, as illustrated in FIG. 9, the stack is assembled by vertically stacking the plates, the gasket, and the seal 50 constituting the plate on a ground surface.

[0013] However, during assembling the stack, a portion of the stack is moved, and in this case, since the seal 50 inserted into the groove of the lower surface in the plate is smaller than the groove, there have been inconvenience during assembling due to the separation of the seal 50 from the groove by gravity.

[0014] In addition, one of limitations in deteriorating performance of a redox flow battery is shunt current loss. The shunt current loss will be described with reference to

[0015] FIGS. 4 and 5. FIG. 4 is a schematic diagram for describing a structure of a redox flow battery, which describes an ideal electron flow. The redox flow battery supplies electrons by using current plates or current collectors disposed at both ends of the stack, while the supplied electrons flow inside a cell, an electrochemical reaction occurs.

[0016] However, since the electrolyte is a material having high electrical conductivity and an internal resistance of the cell increases, electrons are transferred in an arrow direction of FIG. 5 through a flow hole having a relatively low resistance due to characteristics of electricity.

[0017] Therefore, when the stack is designed, it is necessary to prevent the shunt current loss.

[0018] In this regard, a seal is disclosed in Korean Patent Laid-Open Application No. 10-2013-0040826 entitled "MEMBRANE STACK FOR MEMBRANE-BASED PROCESS AND METHOD OF PRODUCING MEMBRANE FOR THE SAME", but the above-described problems are not solved.

DETAILED DESCRIPTION OF THE INVENTION

TECHNICAL PROBLEM

[0019] An object of the present invention is to solve a problem that a seal inserted into a groove of a lower surface in a plate is separated from the groove by gravity during assembling

[0020] In addition, another object of the present invention is to prevent a shunt current loss that deteriorates performance of a redox flow battery.

TECHNICAL SOLUTION

[0021] The present invention relates to a redox flow battery or fuel cell stack assembled by stacking a plurality of plates, wherein a seal is disposed between the plurality of plates, and grooves is placed are formed only on surfaces facing upper portions of the plurality of plates at the time of assembling and are not formed on surfaces facing lower portions of the plurality of the plates, the seal being placed in the grooves.

[0022] According to the present invention, the seal may include a seal disposed along outsides of the plates between the plurality of plates.

[0023] In addition, the present invention relates to a redox flow battery or fuel cell stack assembled by stacking a plurality of plates, wherein a electrolyte flow channel is formed in some of the plurality of plates, and the plates in which the electrolyte flow channel is formed includes: a seal disposed along outsides thereof; and a seal that is disposed adjacent to the electrolyte flow channel.

[0024] According to the present invention, the electrolyte flow channel is formed so as to have overlapping portions when viewed from one direction, and the seal extends between the overlapping portions.

[0025] According to the present invention, the plates in which the electrolyte flow channel is formed may further include: an electrolyte passage in which the electrolyte flow channel is not formed; and a seal surrounding the electrolyte passage.

[0026] According to the present invention, the seal disposed along the outsides of the plates, the seal adjacent to the electrolyte flow channel, and the seal surrounding the electrolyte passage may be are integrally formed.

ADVANTAGEOUS EFFECTS OF THE INVENTION

[0027] According to the present invention, the groove is removed from a surface facing the lower portion of the plate adjacent to the seal and is formed only on a surface facing the upper portion thereof, and during assembling the stack, the seal is not allowed to follow the lower surface of the plate, thereby improving efficiency of assembling. In addition, the seal is formed at a position between lines of the electrolyte flow channel or adjacent to the electrolyte flow channel, thereby preventing the electrolyte from deviating from the electrolyte flow channel to prevent the shunt current loss.

DESCRIPTION OF THE DRAWINGS

[0028]

FIG. 1 is a schematic diagram of a redox flow battery to which the present invention is applied.

FIG. 2 is an exploded perspective view of an existing redox flow battery.

FIG. 3 is a diagram for describing a state in which a seal is assembled between plates.

FIG. 4 is a schematic diagram for describing an ideal electron flow.

FIG. 5 is a schematic diagram of a stack, which describes an occurrence of shunt current loss.

FIG. 6 is a diagram for describing an electrolyte passage formed in a plate and an occurrence of shunt current loss.

FIG. 7 is a diagram for describing a state in which a seal is assembled, according to the present invention.

FIG. 8 is a diagram for describing a state in which a seal is stacked, according to the present invention.

FIG. 9 is an assembly diagram of an existing redox flow battery using an existing guide pin.

BEST MODE

[0029] Hereinafter, the present invention will be described in more detail with reference to the accompanying drawings.

[0030] The accompanying drawings illustrate exemplary forms of the present invention and are provided to describe the present invention in more detail, and the technical scope of the present invention is not limited to the accompanying drawings.

[0031] Redox flow battery or fuel cell stacks according to the present invention have a repeatedly stacked structure, and a structure of a stack 1 is simplified and is illustrated in FIG. 2.

[0032] As illustrated in FIG. 9, the stack is assembled in a manner of stacking from bottom to top.

[0033] During assembling, a seal 50 for preventing leakage of an electrolyte is disposed between plates such as an end plate 11, an insulating plate 12, a current plate 13, a bipolar plate 14, and a flow frame 16, which constitute the stack.

[0034] The seal 50 may be a gasket 15 having a plate shape, an O-ring having a circular rubber shape, and a string-shaped gasket having various plane shapes.

[0035] The seal 50 is mounted so as to be inserted into a groove formed a plate stacked from top to bottom. Since a size of the groove is equally to or greater than a cross sectional area of the seal 50, before the seal 50 is compressed, the seal 50 is not fit in the groove but is placed in the groove (see FIG. 3).

[0036] However, during assembling the stack, some parts of the stack is moved, and while the seal 50 inserted into the groove of the lower surface in the plate is moved together with the plate, there has been inconvenience during assembling due to the separation of the seal 50 from the groove by gravity.

[0037] Therefore, in the present invention, the groove is removed from the lower surface of the plate adjacent to the seal 50 and is formed only on an upper surface, and when a portion of the stack is moved, the seal 50 is not allowed to follow the lower surface of the plate, thereby improving efficiency of assembling.

[0038] In addition, in the stack according to the present invention, shunt current loss occurs because a resistance value of an electrolyte passage is lower than an internal resistance of a cell, and accordingly, the resistance value of the electrolyte flow channel is increased, the shunt current loss may be prevented. The most commonly used method is a method of lengthening a flow channel longer.

$$R = L/A$$

[0039] A resistance R is proportional to a length L and is inversely proportional to a cross sectional area A. Therefore, since a resistance is increased by lengthening the length L of the flow channel, in the present invention, the electrolyte flow channel is lengthily formed by forming an electrolyte flow channel 16c from an electrolyte passage 16a to an ion exchange membrane 18 so as to have overlapping portions such as a "2" shape or an "S" shape when viewed from one direction (arrow direction of FIG. 7).

[0040] In the present invention, a method of lengthily forming the electrolyte flow channel 16c includes a method of forming the "2" shape or the "S" shape as well as other methods of forming modifications that can be easily construed by the technicians in the art.

[0041] However, when the electrolyte flow channel 16c having the "2" shape or the "S" shape is installed, the electrolyte may be directly moved to an area of the ion exchange membrane 18 from the electrolyte passage 16a rather than the electrolyte flow channel 16c as indicated by an arrow (illustrated in FIG. 6), and in this case, a moving path of the electrolyte may be shortened, resulting in reducing the resistance value of the electrolyte passage and generating the shunt current loss.

[0042] Therefore, in the present invention, a seal 50b may be further installed adjacent to the electrolyte flow channel and/or between the overlapping portions, thereby preventing the electrolyte from deviating from the electrolyte passage 16a or the electrolyte flow channel 16c to prevent the shunt current loss.

[0043] In addition, as illustrated in FIG. 7, the leakage of the electrolyte is prevented by forming a seal 50a surrounding an outside of the plate and forming a seal 50c surrounding an electrolyte passage 16b in which the electrolyte flow channel is not formed.

[0044] Furthermore, in the present invention, the electrolyte is prevented from deviating the electrolyte flow channel 16c and is prevented from leaking from the flow frame 16 by integrally forming the seal 50a surrounding the outside of the frame and the seal 50b disposed inside the electrolyte flow channel or integrally forming the seals 50a and 50b and the seal 50c surrounding the electrolyte passage 16b.

[0045] While the electrolyte flow channel has been described as an example as being formed in the flow frame 16, the electrolyte flow channel may be formed in other plates rather than the flow frame 16.

Claims

1. A redox flow battery stack assembled by stacking a plurality of plates, the redox flow battery stack comprising an electrolyte passage and an electrolyte flow channel, which are formed in some of the plurality of plates,
wherein overlapping portions are formed at the electrolyte flow channel when viewed from one direction, and the plates in which the electrolyte flow channel is formed comprises:

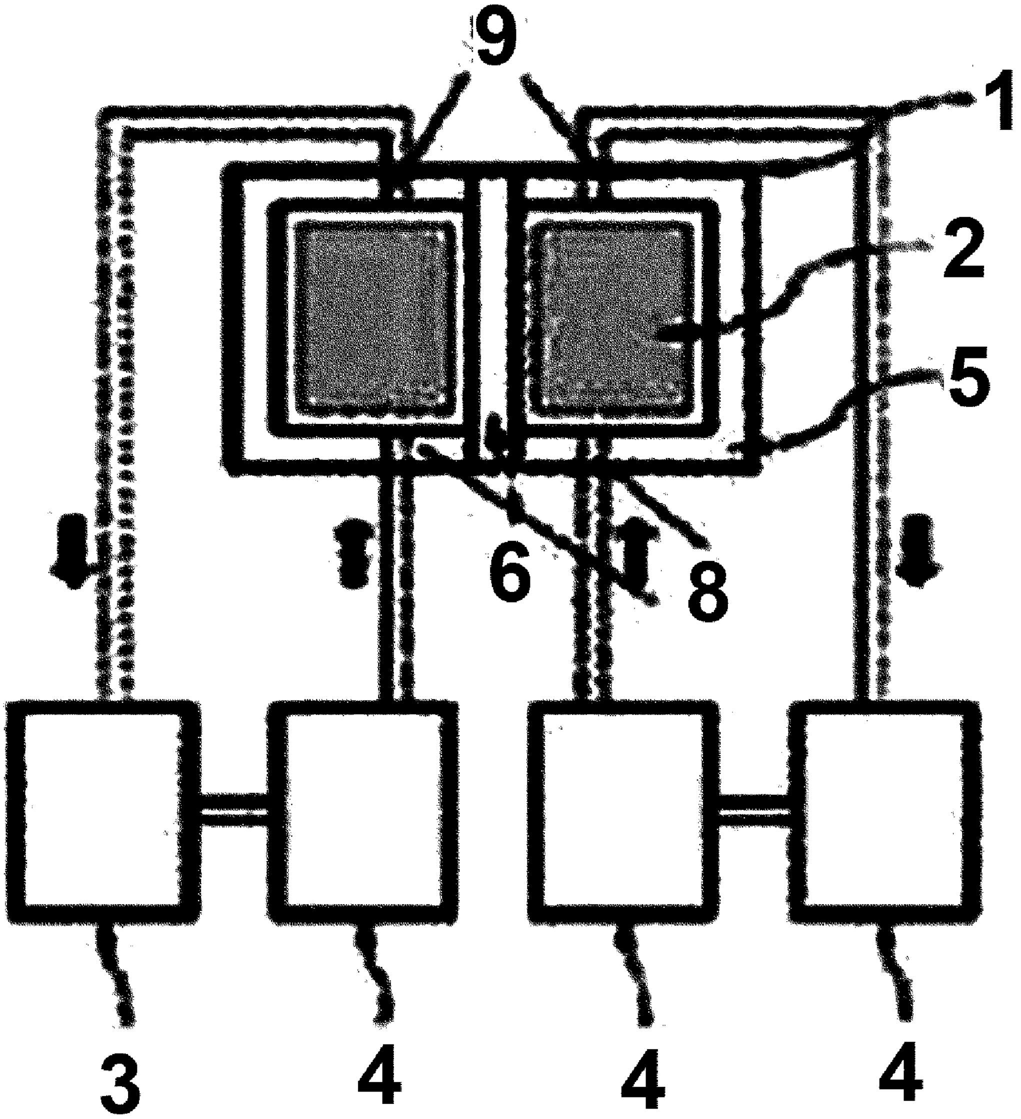
    a seal that is disposed along outsides thereof; and
    a seal that is disposed adjacent to the electrolyte flow channel and extends between the overlapping portions such that an electrolyte is prevented from being directly moved from the electrolyte passage to an ion exchange membrane and is prevented from deviating from the electrolyte flow channel,
    wherein grooves are formed only on surfaces upward directed at the time of assembling at the plates in which the electrolyte flow channel is formed, the seals being placed in the grooves.

2. The redox flow battery stack of claim 1, wherein the plates in which the electrolyte flow channel is formed further comprises:

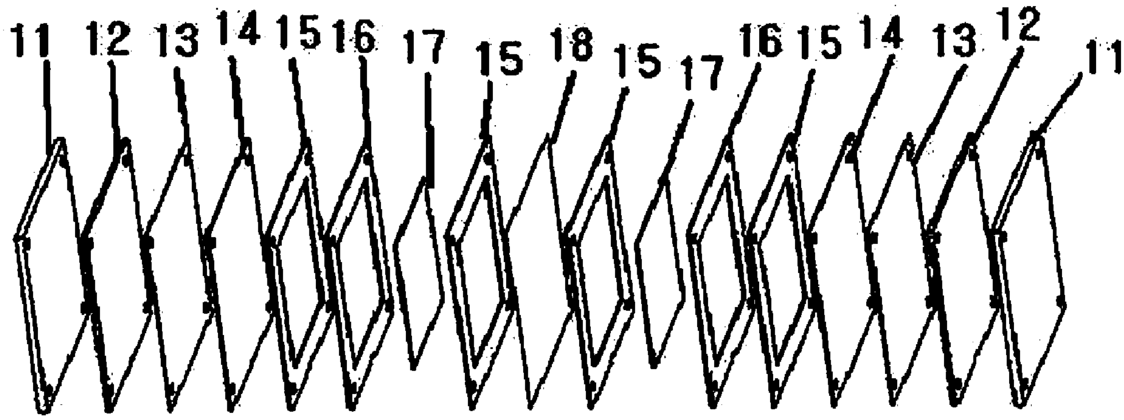
    an electrolyte passage in which the electrolyte flow channel is not formed; and
    a seal surrounding the electrolyte passage, and the electrolyte flow channel has a "2" shape or an "S" shape.

3. The redox flow battery stack of claim 1 or 2, wherein the seal disposed along the outsides of the plates and the seal adjacent to the electrolyte flow channel are integrally formed, or the seal disposed along the outsides of the plates, the seal adjacent to the electrolyte flow channel, and the seal surrounding the electrolyte passage are integrally formed.

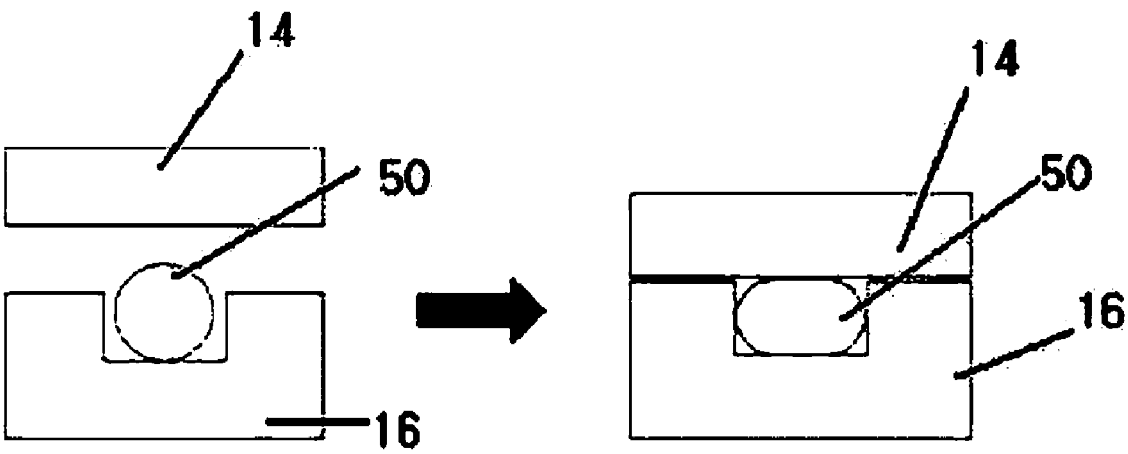
[Fig. 1]



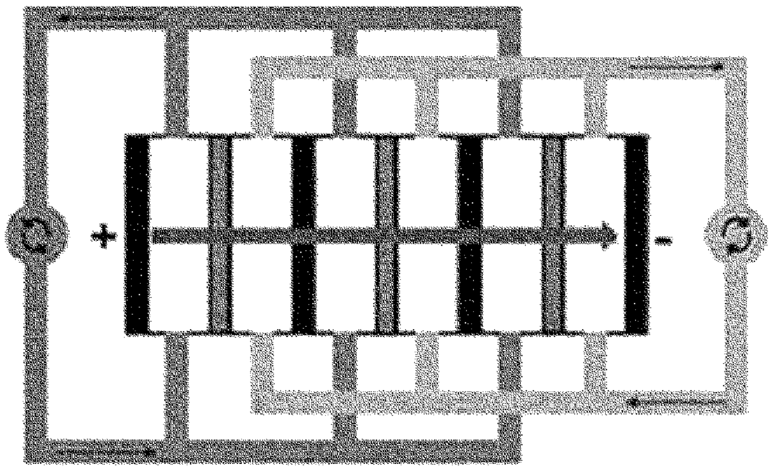
[Fig. 2]



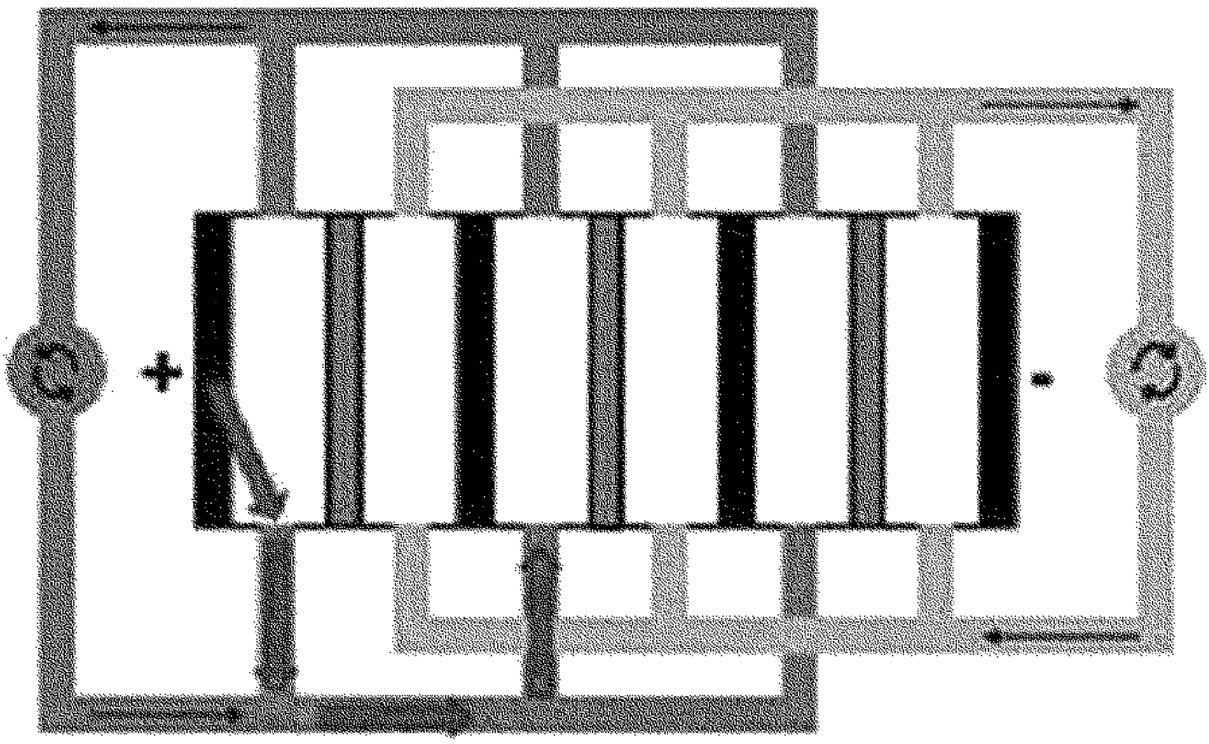
[Fig. 3]



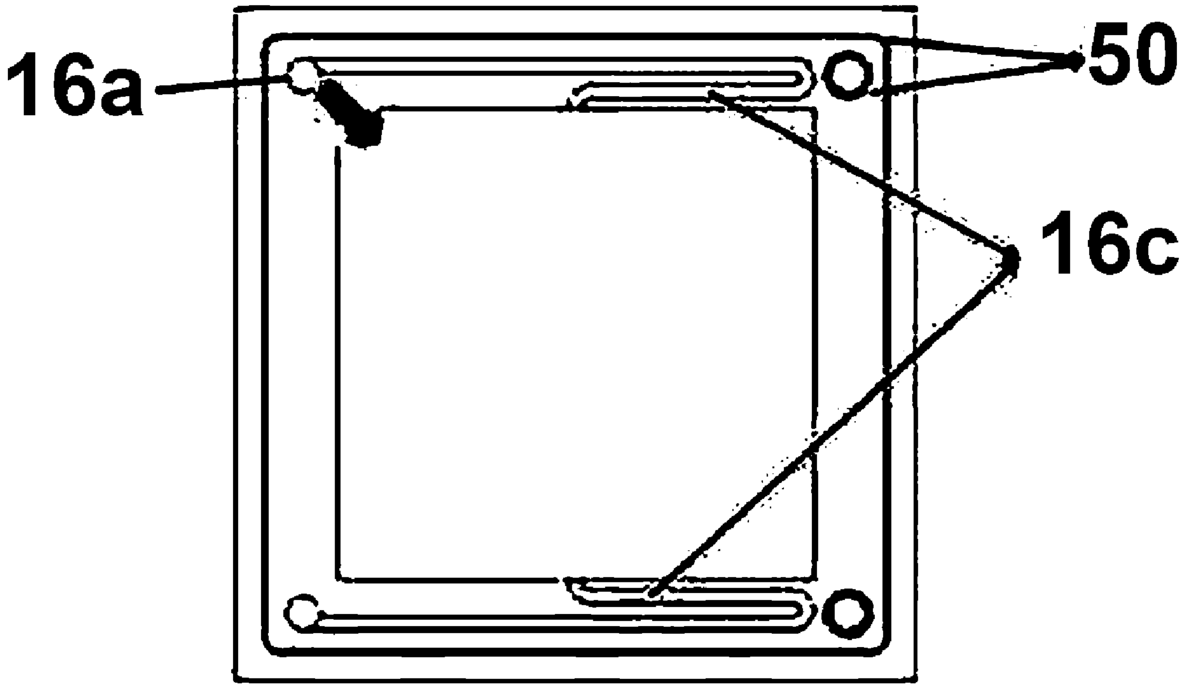
[Fig. 4]



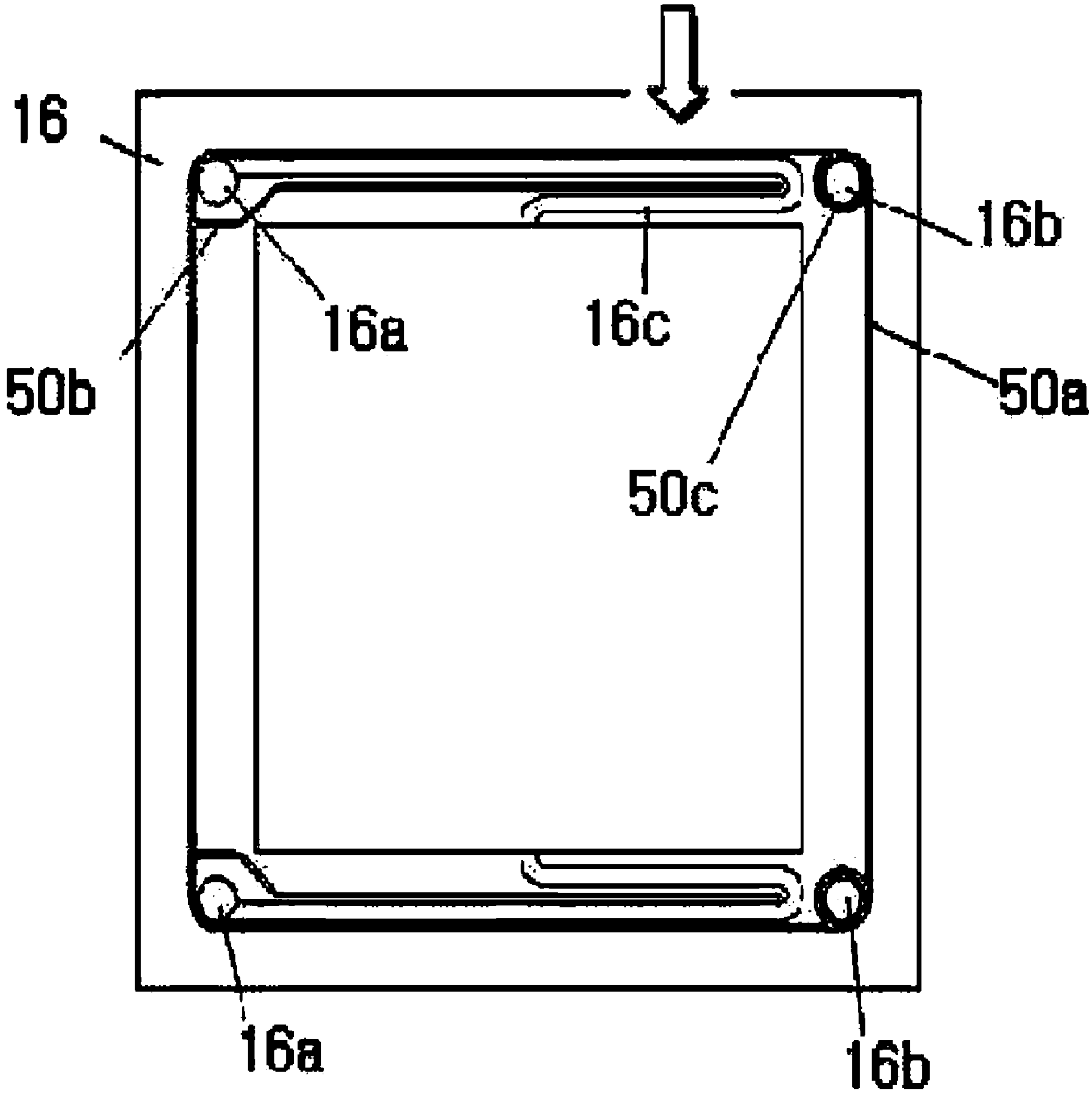
[Fig. 5]



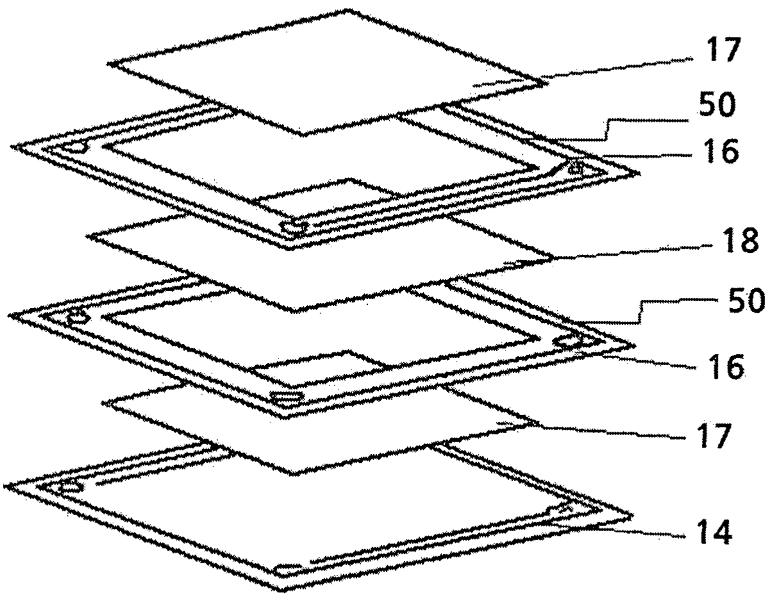
[Fig. 6]



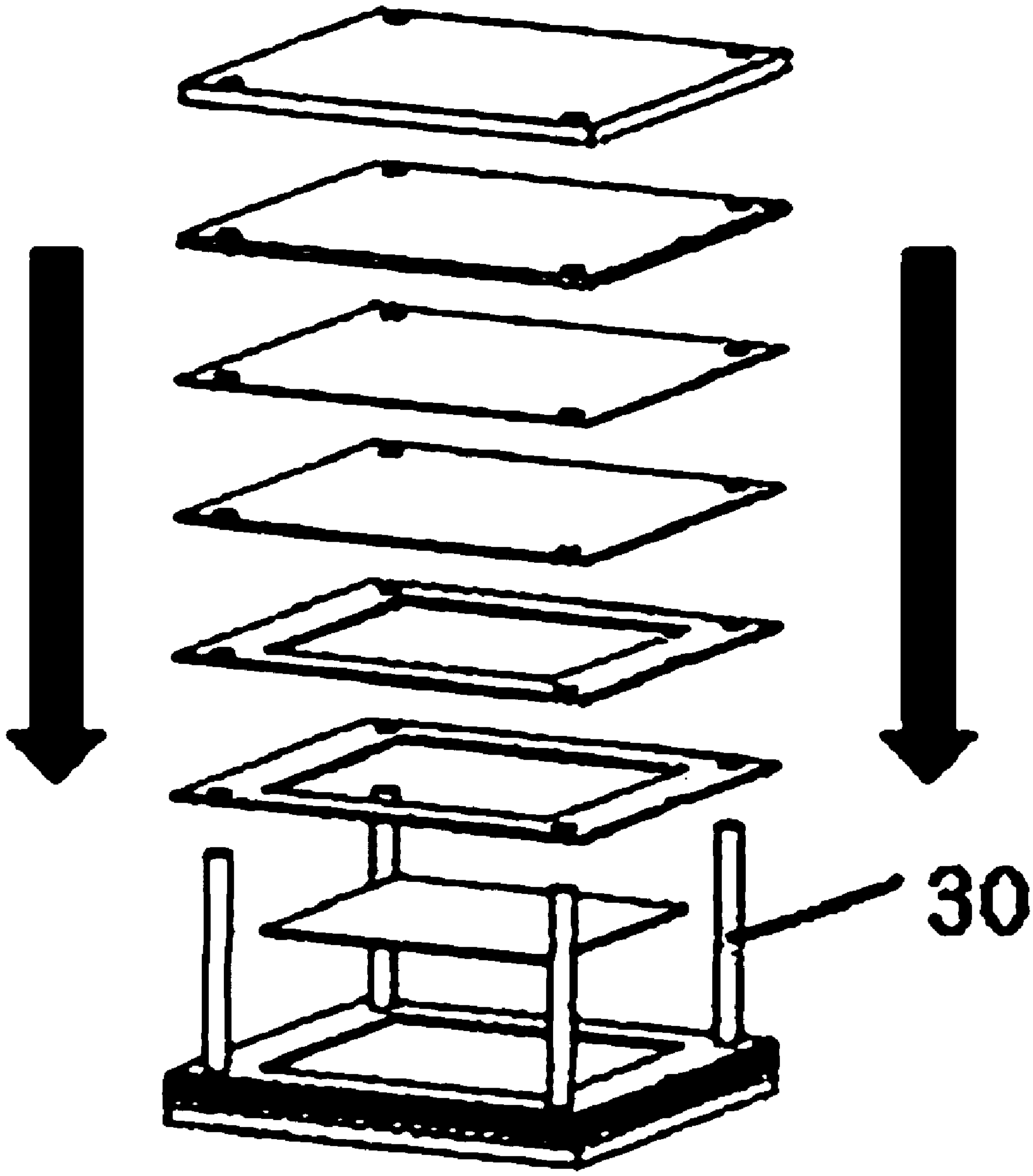
[Fig. 7]



[Fig. 8]



[Fig. 9]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2014/006366

A. CLASSIFICATION OF SUBJECT MATTER

H01M 8/02(2006.01)i, H01M 8/18(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H01M 8/02; H01M 8/18; H01M 8/04; H01M 8/24

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean Utility models and applications for Utility models: IPC as above
Japanese Utility models and applications for Utility models: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS (KIPO internal) & Keywords: fuel cell & shunt current & seal & (passage | channel)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 8004010 B2 (WESTERN ELECTRIC CO., LTD.) 17 January 1996 See figure 2 and page 4 relevant paragraphs.	1-3
A	CN101587959 A (DALIAN RONGKE POWER CO., LTD.) 25 November 2009 See page 5 specific implementation methods and figure 2a	1-3
A	JP 3143613 B2 (SUMITOMO ELECTRIC INDUSTRIES CO., LTD., WESTERN ELECTRIC CO., LTD.) 07 March 2001 See paragraph 0030, figure 3	1-3
A	JP 2007-299550 A (TOYOTA MOTOR CORP) 15 November 2007 See paragraph 0029, figure 3(d)	1-3
A	KR 10-2009-0078550 A (SAMSUNG ELECTRONICS CO., LTD.) 20 July 2009 See abstract, claim 1, figure 3	1-3

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 OCTOBER 2014 (13.10.2014)	**13 OCTOBER 2014 (13.10.2014)**

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Facsimile No. 82-42-472-7140

Authorized officer

Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2014/006366

Patent document cited in search report	Publication date	Patent family member	Publication date
JP 8004010 B2	17/01/1996	NONE	
CN101587959 A	25/11/2009	CN101587959 B	16/05/2012
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JP 2007-299550 A	15/11/2007	JP 5028856 B2	19/09/2012
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		US 2009-0181272 A1	16/07/2009
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Form PCT/ISA/210 (patent family annex) (July 2009)